

REMARKS

In paragraph 1 of the Office Action, the Examiner indicated that applicant had not filed the certified copy of the United Kingdom priority document. Applicant encloses herewith a copy of the certified copy of the United Kingdom priority document, as well as the transmittal page and the returned postcard, which indicates that the USPTO received the original certified copy on July 06, 2004.

In paragraph 4 of the Office Action, claims 1-10, 19-21, 27-31 and 33 were rejected under 35 U.S.C. 112, second paragraph, as being indefinite. Regarding claim 1 (Paragraph 4.I), applicant amends this claim to more particularly point out that the claimed article is the uncured pigmented layer that comprises an uncured pigmented binder resin and a substrate on which the pigmented binder resin is located. The claim is also amended to point out that the intended use for the claimed article is to attach it directly to an uncured prepreg. Claim 1, as now amended, does not require that the claimed article include an uncured prepreg.

Regarding claim 19 and 21 (Paragraph 4.II), applicant amends these claims so that they now properly depend from claim 11, which is the base claim for the panel assembly. Applicant also amends claims 23 and 30, so that they now properly depend from claim 22, which is the base claim for the method. Claim 27 has not been amended since it is dependent upon claim 23 and the amendment to claim 23 removes the inconsistency pointed out by the Examiner in Paragraph 4. III of the Office Action.

Regarding claims 21 and 33 (Paragraph 4.IV), the unclear language cited by the Examiner has been removed as being unnecessary and confusing. The presence or use of a substrate is preferred, but not required, for the panel assembly and method (See Paragraph 31 of the specification). Claims 11 and 15-17 have been amended to more particularly point this out.

In paragraphs 5-8 of the Office Action, claims 1, 4 and 9 were rejected under 35 U.S.C. 102 as being anticipated by Meyer et al. Applicant amends claim 1 to distinguish the claimed substrate from the mold taught by Meyer. Specifically, the limitations of claim 2 requiring that the substrate be a textile substrate and/or a film substrate have been added to claim 1. The limitation in claim 2 that the film be thermoplastic has not been included, since the requirement that the substrate is a textile substrate and/or a film substrate provides a sufficient distinction over Meyer. The combination of uncured pigmented binder resin and substrate, as now claimed, is not anticipated by Meyer's combination of a mold coated with a resin composition that includes a pigmenting agent. Claims 4 and 9 depend from claim 1, so that the amendment to claim 1 also provides a distinction

between these dependent claims and Meyer. Applicant noted in reviewing the claims that claim 4 included language that might be considered to lack antecedent basis. Applicant amends claim 4 to overcome this perceived problem.

In view of the above amendments and remarks, applicant respectfully requests that this application be reexamined and allowed.

Respectfully Submitted,

Date: January 03, 2006

/David J. Oldenkamp/

David J. Oldenkamp, Reg. #29,421

HEXCEL CORPORATION

11711 Dublin Boulevard

Dublin, California 94568

Phone: 925-551-4900 x 4394

FAX: 925-828-3268



PATENT

Client Name & Docket No. Hexcal (0179.0047)
Title: PIGMENTED PANEL ASSEMBLY
Applicants: Blair et al.
Serial No.: 10/814,413
Filing Date: March 30, 2004

Please acknowledge receipt of:

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- ☒ Copy of Missing Parts Notice
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Dated: June 30, 2004 By: David J. Oldenkamp/gv



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PATENT

Attorney Docket No. 0179.0047

Serial No. 10/814,413

Filed: March 30, 2004

Title: PIGMENTED PANEL
ASSEMBLY

Applicants: Blair et al.

Group Art Unit No. 1772

Examiner: n/a

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SUBMISSION OF PRIORITY DOCUMENT

Sir:

Applicant submits herewith a certified copy of the priority document for the above-identified application. The particulars of this priority document are as follows:

| | |
|------------------|----------------|
| Application No.: | 0307697.3 |
| Country: | United Kingdom |
| Filing Date: | April 2, 2003 |

Respectfully submitted,

Dated: June 30, 2004

David J. Oldenkamp, Reg. 29,421
SHAPIRO & DUPONT LLP
233 Wilshire Boulevard, Suite 700
Santa Monica, California 90401
(310) 319-5411 (Telephone)
(310) 319-5401 (Facsimile)



INVESTOR IN PEOPLE

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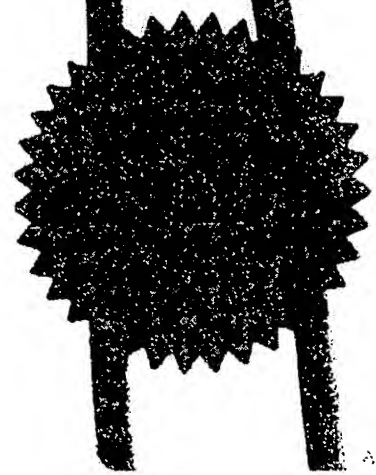
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Dated 12 March 2004





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1. Your reference

MG/LAT/LM/P/21859.GB

2. Patent application number

(The Patent Office will fill in this part)

0307697.3

3. Full name, address and postcode of the or of each applicant. (underline all surnames)

Hexcel Composites Limited
Duxford
Cambridge
CB2 4QD

0632 555 4001

Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

4. Title of the invention

A PIGMENTED PANEL ASSEMBLY

5. Name of your agent (if you have one)

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

WILSON GUNN M'CAW
41-51 ROYAL EXCHANGE
CROSS STREET
MANCHESTER
M2 7BD

Patents ADP number (if you know it)

7153927001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country

Priority application number
(if you know it)

Date of filing
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7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing
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8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer "Yes" if:

Yes

- a) any applicant named in part 3 is not an inventor, or
 - b) there is an inventor who is not named as an applicant, or
 - c) any named applicant is a corporate body.
- See note (d))

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Continuation sheets of this form

Description 12

Claim(s)

Abstract

Drawing(s) 2

10. If you are also filing any of the following, state how many against each item.

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Translations of priority documents

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Request for preliminary examination and search (Patents Form 9/77)

Request for substantive examination (Patents Form 10/77)

Any other documents (please specify)

11. I/We request the grant of a patent on the basis of this application.

Wilson Gunn M'Caw

Signature

Date 01/04/03

Wilson Gunn M'Caw

12. Name and daytime telephone number of person to contact in the United Kingdom Dr Lucy Tovell 0161 827 9400

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A Pigmented Panel Assembly

The present invention relates to a pigmented panel assembly.

Honeycomb sandwich panels have been used for many years as interior structural components of aircraft, trains and boats. Due to the need for low levels of fire, smoke and toxic emissions in the event of a fire situation, phenolic resin matrices embedded in a reinforcement fibre are typically used as the panel skin material. Examples of this approach are described in US 4880681, US 5714419 and WO 92/17331.

In order to provide aesthetic appeal to these panels it is customary to apply a top layer of decorative material such as Tedlar[®] polyvinyl fluoride film to the outer surface of the panel. These decorative sheets may be patterned as in an aircraft cabin or plain coloured as in aircraft luggage holds, galleys and other enclosures and compartments. Current methods of applying the top layer to the panel have a limited process temperature interval due to the nature of the adhesive used to bond the decorative material to the panel's outer surface. This can restrict processing to temperatures of 90 to 130°C depending upon the adhesive used. Since the resin matrix of the panel is typically cured at a temperature from 140°C to 160°C two separate curing steps are required. This is regarded as a disadvantage as it increases processing times and costs.

Attempts have been made to address this problem. For example, US 4599212 discloses a reinforced phenolic laminate panel having a finishing coat of a butylated phenol-formaldehyde resin in which the finishing coat can be mass-pigmented to the desired colour. However, in this context mass-pigmented means homogeneously pigmented throughout the whole body of the laminate panel.

JP 2000071365 discloses a method of producing a decorative sheet by successively providing a base material layer, an expanded thermoplastic resin layer containing blowing agents and a coloured thermoplastic resin layer containing titanium dioxide such that the top layer shields the yellowing of the expanded foam layer caused by the blowing agents. However, JP 2000071365 does not address fibre reinforced thermoset resin layers.

Pigmented gel coats are known in the composites molding industry but these are pre-applied to the mold surface either by painting or spraying. Furthermore, gel coats are mixtures of resin and curing agents that are of a different formulation from, but capable of being co-cured with, the resin matrix. Scrim-based gel coats are also known but these also need to be pre-applied to the mold and contain a high level of resin loading. A disadvantage with gel coats is that they have to be cured in the mold as the first stage of the lay-up and curing process.

Attempts have been made to incorporate titanium dioxide directly into a fibre reinforced phenolic resin matrix, but even with loadings as high as 50%, the desired colour intensity was not achieved. In addition, structural integrity such as prepreg to core adhesion deteriorated.

Therefore, it is an object of the present invention to provide a pigmented panel assembly that can be cured at a higher temperature such that a single curing step is sufficient.

According to the first aspect present invention there is provided a pigmented panel assembly comprising a core, at least one prepreg layer and at least one top coat layer, wherein the aforesaid prepreg layer is located between the core and the top coat layer and wherein the said top coat layer comprises at least one pigment and at

least one resin binder, characterised in that the panel assembly is cured in a single curing process.

According to the second aspect of the present invention there is provided a method for the manufacture of a pigmented panel assembly comprising the steps of:-
5 applying at least one prepreg layer to a core, applying at least one top coat layer to the aforesaid core and/or the aforesaid prepreg layer such that the said prepreg layer is located between the core and the top coat layer and wherein the said top coat layer comprises at least one pigment and at least one resin binder, characterised in that the panel assembly is cured in a single curing process.

10 Advantageously, the pigmented top coat layer and the prepreg layer are such that they can be co-cured in a single curing step, thereby increasing the process efficiency of the manufacture of pigmented panel assemblies.

A further advantage of the present invention is that the pigmented top coat layer does not contain any matrix resin nor does it penetrate into the lower prepreg
15 layers during curing thus maintaining the desired colour intensity. There are several methods of determining colour level including ASTM D2457-90 which is a test method for specular gloss and ANS AATCC, a measure of colourfastness. It was found that use of a hand-held spectrophotometer such as an X-Rite SP-60 was a convenient tool to measure laminate colours. A D65 illuminant can be used to mimic
20 sunlight and measurement in specular exclusive or inexclusive mode.

A still further advantage of the present invention is that during curing the top coat layer chemically bonds with the prepreg layer to which it is applied thereby eliminating the need for additional adhesive materials as is the case with prior art systems.

The panel assembly of the present invention is preferably cured at a temperature upto 160°C.

The core of the present invention may comprise flame retardant foams, honeycomb or even balsa. Preferably, the core comprises a non-metallic honeycomb, although metallic honeycombs may also be used.

The core most preferably comprises non-metallic honeycombs based on Nomex® or calendered kraft paper such as that described in EP 0967070 A1. Typical honeycombs range from 29 to 89 kgm⁻³ in density and have cell sizes from 3 to 5 mm. The honeycomb may also be over-expanded for use in highly contoured parts. Ideal honeycombs are A1-48-3 and A1-80-3 available from Hexcel Composites Ltd., Duxford, UK.

The panel assembly of the present invention preferably comprises at least two prepreg layers. The prepreg layers may be applied to opposite sides of the core such that each side of the core has at least one prepreg layer applied thereto or the prepreg layers may be applied to the same side of the core such that a second prepreg layer is applied to the surface of a first prepreg layer.

The prepreg of the present invention preferably comprises a thermoset resin matrix together with a reinforcement material.

The resin matrix of the present invention is chosen such that it is able to provide the necessary FST properties. Suitable resin matrices which can be used alone or in combination are based on phenolic resole, phenolic novulac or flame retardant epoxy systems.

Preferably the resin matrices of the present invention which can be used alone or in combination include any of: HexPly® HT 93, HexPly® M25, HexPly® M26 and HexPly® M41 available from Hexcel Corporation.

The reinforcement of the present invention may be made from synthetic or natural fibres which may be of a unidirectional or fabric construction, but are preferably of fabric construction.

Suitable fabrics which can be used alone or in combination include any of the following textile forms: plain, twill and satin weave carbon fabrics. Preferably, the fabric textile form is a satin weave glass fabric having a weight ranging from 105 gm² (style 120) and 295 - 303 gm² (style 7781).

In some circumstances, non-woven materials such as random fibre-oriented mats or veils may also be used. These materials can be beneficial for more contoured panels where good drape is required in the moulding tool.

The prepreg of the present invention is prepared by techniques well known to those skilled in the art. The preferred method involves solution impregnation of the reinforcement followed by solvent removal in a vertical oven.

The pigment(s) of the topcoat layer is chosen out of consideration for the desired colour. Furthermore, any colour combination is feasible such that the desired colour is afforded. For many applications light colours are desirable and in particular white which is achieved by way of rutile titanium dioxide. There are many suitable grades of titanium dioxide with Kemura TiO₂, Tronox RDDI or Tioxide TR81 being particularly suitable as they also give improved resistance to UV degradation. These are available from Kemira Pigments, Helsinki, Finland and Huntsman Tioxide, Calais, France, respectively.

The pigment preferably constitutes from 10% to 40% by weight of the topcoat layer and more preferably from 20% to 35% by weight of the topcoat layer.

Preferably the resin binder of the topcoat layer is thermoplastic, its choice being limited solely by its compatibility with the resin matrix of the prepreg layer(s).

5 Furthermore, the resin binder must be capable of forming a film, a property it gives to the topcoat layer.

Suitable resin binders, which may be used alone or in combination include any of: polyvinylacetal, polyvinyl fluoride (PVF) or polyvinyl alcohol (PVA).

Where the resin matrix of the prepreg is a phenolic resin matrix, polyvinyl
10 butyral has been found to be a particularly suitable resin binder. In this case, the preferred resin binder is Butvar[®] B90 available from Solutia Inc., St. Louis, Missouri.

Additional ingredients may optionally be added to the topcoat layer, these include but are not limited to performance enhancers or modifiers such as in-situ fire barriers (Ceepree[®] CGB6-220M from Ceepree Products Ltd, Southport, UK) and
15 viscosity control agents i.e. thixotropes (Cabosil[®] from Cabot Corp., Tuscola, Illinois). These additional ingredients preferably comprise from 0% to 6% by weight of the topcoat layer.

The pigmented topcoat layer may be prepared as a paste by dissolving the resin binder in a suitable solvent, for example industrial methylated spirit (IMS) and
20 adding to this the required amount of pigment. Alternatively a water emulsion of resin binder can be prepared and the pigment dispersed therein as desired.

Preferably the topcoat layer is applied to the prepreg layer(s) before lay-up via a suitable substrate. The paste material described above is applied to the substrate using standard coating techniques such as blade coating, reverse roll coating, forward

roll coating, solution dipping and film extrusion. Alternatively, the paste may be applied to the substrate such that the paste impregnates the substrate. The coated or impregnated substrate is then passed through an oven to remove the solvent and wound onto a roll. If desired, an interleaf material such as release paper or polyethylene film can also be incorporated. The substrate may be either a textile or a thermoplastic film.

Where the substrate is a thermoplastic film it is preferable that it has a melting point greater than 160°C and more preferably greater than 200°C . Suitable thermoplastic film substrates include polyethylene terephthalate (PET), particularly suitable grades including PET-W-50-S20, PET-N-36-S30, PET-N-50-S40 and PET-N-36-S10 ideally having a thickness between 36 and 50 μm . These films are available from API Coated Products Ltd., Cheltenham, UK. The use of a PET film can improve the quality of the surface finish due to the superior quality of surface of the PET film over the steel surface of the press platens.

The selection of the appropriate textile substrate is dependent upon the finished panel assembly construction requirements. In some instances the textile only needs to support the topcoat layer i.e. the resin binder and the pigment, and can therefore be of lighter weight, whereas other instances may require some structural contribution from the textile, in which case heavier weights will be required.

Suitable textile substrates preferably have areal weight below 150gm^{-2} . For example, plain weave glass fabric having an areal weight of 20gm^{-2} (style 104), 4-harness stain weave glass having an areal weight of 105gm^{-2} (style 120), both of which are available from Hexcel Fabrics S.A. Villeurbanne, France. Further examples of suitable textile substrates include, but are not limited to warp knitted

nylon 6 carrier at 10gm^{-2} (style A1050), plain weave nylon 6.6 carrier at 22gm^{-2} (style K4590), reed and pick cotton scrim cloth at 13 to 23gm^{-2} and polyester or glass mats such as 6gm^{-2} (T2178/09 polyester mat from Technical Fibre Products, Kendal, UK).

The finished topcoat layer i.e. the substrate, the resin binder and the pigment preferably have a weight range from 20 to 170gm^{-2} and more preferably from 40 to 150gm^{-2} .

Where the pigmented topcoat material is coated or impregnated onto a substrate, the topcoat layer is applied by lamination of the substrate onto the prepreg layers as the last stage of the production process.

Where the pigmented topcoat is not coated or impregnated onto a substrate, the paste material may be sprayed directly onto the prepregs layer(s).

The present invention will now be described further by way of example only and with reference to the following example drawings in which:-

Fig. 1 shows a section through a panel assembly in accordance with the prior art;

Fig. 2 shows a section through one embodiment of the present invention;

Fig. 3 shows a section through a second embodiment of the present invention;

Fig. 4 shows a section through a third embodiment of the present invention;

and

Fig. 5 shows a section through a fourth embodiment of the present invention.

A typical prior art panel assembly is shown in Fig. 1. The panel assembly 1 comprises a Nomex[®] A1-48-3 core 2 having a single layer of an M41 phenolic matrix and 7781 glass reinforced prepreg 3 applied to both of its outer surfaces and a second layer 4 of the said prepreg applied to the first layer thereby providing a 2 ply prepreg

system. The core 1 and the prepreg 3 and 4 may be cured either by a crush core process of hot loading and curing at 140°C for 7 minutes under sufficient pressure to crush the panel assembly to the required thickness (typically 60 to 70 Bar pressure to the press platens) or an open press process of cold loading and curing at 135°C for 30 minutes at 0.9 to 4.0 Bar pressure. A decorative topcoat layer 5 is then applied to the outer surface of the second prepreg layer by way of an adhesive 6. The adhesive 6 is then cured in a second bonding step at 90°C and 3 Bar pressure.

Fig. 2 shows a section through one embodiment of a panel assembly 7 according to the present invention having a honeycomb Nomex[®] A1-48-3, wherein both of its outer surfaces has a single layer of an M41 phenolic matrix and 120 glass reinforced prepreg 9. A topcoat layer 10 comprising titanium dioxide pigmented Butvar on a 120 glass substrate is applied to the outer surface of the said 120 glass reinforced prepreg 9. The panel assembly 7 is then cured by way of a crush core process, wherein the panel assembly is hot loaded and cured at 140°C for 7 minutes under sufficient pressure to crush the panel assembly to the required thickness (typically 60 to 70 Bar pressure to the press platens).

Fig. 3 shows a section through a second embodiment of a panel assembly 11 according to the present invention having a honeycomb Nomex[®] A1-48-3 core 12 wherein two layers of an M41 phenolic matrix and 7781 glass reinforced prepreg 13 and 14 are applied to each outer surface of the core. A topcoat layer 15 comprising titanium dioxide Butvar[®] on a PET film substrate is applied to one of the outer surfaces of the prepreg. The panel assembly 11 is then cured by way of a crush core process, wherein the panel assembly 11 is hot loaded and cured at 140°C for 7

minutes under sufficient pressure to crush the panel assembly 11 to the required thickness (typically 60 to 70 Bar pressure to the press platens).

Fig. 4 shows a section through a third embodiment of a panel assembly 16 according to the present invention having a honeycomb Nomex[®] A1-48-3 core 17, wherein two layers of an M41 phenolic matrix and 7781 glass reinforced prepreg 18 and 19 are applied to each of the cores outer surfaces. A topcoat layer 20 comprising titanium dioxide pigmented Butvar[®] on a polyester matt substrate is applied to one of the outer surfaces of the 2 layer prepreg. The panel assembly 16 is then cured by way of a platten press. The panel assembly 16 is cold loaded and cured at 135°C for 30 minutes at 0.9 to 4.0 Bar pressure.

Fig. 5 shows a section through a fourth embodiment of a panel assembly 20 according to the present invention having a honeycomb Nomex[®] A1-48-3 core 21, wherein two layers of an HT93 phenolic matrix and 7781 glass substrate prepreg 22 and 23 are applied to each of the cores outer surfaces. A topcoat layer 24 comprising titanium dioxide pigmented Butvar[®] on a PET film substrate is applied to each outer surface of both the prepreg layers. The panel assembly 20 is then cured by way of a platten press, wherein the panel assembly 20 is cold loaded and cured at 135°C for 90 minutes at 3 Bar pressure.

The following example further illustrates the present invention:-

Example 1

An example of a pigmented topcoat layer composition.

| Material | % by weight included |
|------------------------------------|----------------------|
| Burvar B90 ¹ | 63 |
| TiO ₂ RDD1 ⁴ | 30 |
| Carbosil TS720 ³ | 2 |
| Ceoprou CGB6-220M ⁵ | 5 |

NB: These materials are dispersed into an 4:1 IMS:MEK solvent blend with

5 a solids range of 20 to 30% according to the following process:

1. Burvar B90 - Polyvinyl Butyral
2. TiO₂ RDD1 - Alumina-Silica surface treated rutile titanium dioxide.
3. Carbosil TS 720 - Fumed Silica
4. Ceoprou CGB6-220M - Fire barrier material.

10

Example 1 is prepared in the following manner:

1. Mixing vessel charged with IMS
2. Burvar B90 added with stirring, the mixture is stirred until Burvar B90 has
15 completely dissolved
3. TiO₂ pigment added with high speed sheer, mixed until dispersed and the
particle size is below 5µm. Particle size reduction can also be achieved via
triple roll milling if necessary. A Hegman gauge or similar instrument is used
to determine the particle size

4. Cabosil TS720 is added with high speed mixing, and the mixture is mixed until the Cabosil is dispersed. Additional ingredients may be added here.

5. MEK was added and the mixture was stirred until uniform.

NB: The mixer should be a high speed dispersion mixer of appropriate size and power for the size of the batch being made.

It is of course to be understood that the invention is not intended to be restricted to the details of the above embodiment which is described by way of example only.

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